PAVING AND MUNICIPAL ENGINEERING

A Journal Devoted Specially to Street and Sidewalk Paving, Sewerage, Water-Works Construction, Street Lighting, and all Matters Pertaining to Municipal Engineering.

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Articles relating to the different branches of municipal engineering are desired. Stamps should accompany manuscripts for return postage if unavailable.

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The columns of this publication are open to the discussion of all subjects relating to paving, sewerage, water-works, street-lighting, and the physical improvement of cities. Practical information as to the merits of materials used in such work and new methods, with photographs and drawings, which may be used for illustration, are especially desired. We are glad to get brief notes as to proposed improvements and the letting of large contracts.

City engineers are requested to send us as early as possible copies of their annual reports, which will be given proper notice.

Articles relating to methods of road making and maintenance are invited.

DOMESTIC LIGHT AND HEAT FOR CITIES AND TOWNS.

By William Waplington.

ARTIFICIAL light and heat have been more scientifically considered, and, consequently, more advanced during the last fifty years than they were during the rest of the period known as the Christian era.

In the generation of light the generation of heat is absolutely indispensable.

Artificial light, so far as we know it, is the incandescence of some solid body highly heated by the combustion of gases, or by a current of electricity, and the higher the temperature of the solid body is raised, the more incandescent it becomes; in other words, the higher the temperature, the greater the light.

In theory, then, the generation of light involves the use of a combustible and a refractory substance to withstand the highest heat of the combustible used.

The fusing point of platinum is exceedingly high and the fussing point of carbon still higher, and, as yet, unknown. Lime is another highly refractory substance. These three bodies afford us all that is necessary for the combustible, and the body to be raised to a highly incandescent state, and they give us the advantage of two well known systems of lighting: First. Lighting by the combustion of ordinary gas, and second, by the electric current. The carbon must, of course, be in the state of coal.

In the coal gas system the incandescent carbon is not permanent, neither is it in the electric arc light, but it contributes in a marked manner or degree to the incandescence, by its own heat of combustion; in fact, it furnishes practically all the incandescence of the gas flames.

Without carbon, or some other substance, to become incandescent, a gas flame will furnish a very poor light, even when a very high temperature is attained. On the other hand, unless a very high temperature is reached, the incandescence will be correspondingly low, proving, or at least appearing to me, that high temperatures, such as we are acquainted with, are not sufficient for intense light. There may be temperatures that would render gases incandescent. The primary condition for producing intense light is the production of intense heat; in fact, it seems clear enough to me that heat is the source of all light.

The striking resemblance of the two has been pointed out hundreds of times. All modern text-books on natural philosophy show up this close analogy, and the more recent works extend the similarity of electricty also. The two go hand in hand to a great extent, in fact are inseparable, and it may yet be found that the three are only one in different states. To use the language of the Liturgy "The Trinity in Unity and the Unity in Trinity." So far, however, such a Trinity in Unity is only speculative or hypothesis; to me, however, it appears a hypothesis of much promise, being well supported by numberless facts and practical applications.

The lighting and heating of towns and cities is a branch of applied physics that is now receiving a great deal of attention at the hands of scientists and men of inventive genius; to say nothing of the multitude of quasi-geniuses who are entirely ignorant of natural laws, and obstinately ignore them. They spend a lifetime taking random shots, with the vain hope that they will one day strike something. Very true, some of these random shots have made a strike, and in a solitary case or two, a very good strike. All discoveries are not due to the inductive reasoning of the philospher; some few have been the result of accident, or have been stumbled on by chance, but very nearly all the grand facts revealed to us in the book of nature have been contributed by exact and systematic thinkers, who have by special care and training acquired some knowledge of how to ask nature questions and understand to a great extent the answers she makes. It is on these men we must rely for our improved lighting and heating; they have already accomplished the feat of resolving heat into its electric state—assuming on the above hypothesis—and conveyed and distributed it at distant points as light and heat, both of which may now be termed articles of commerce, the former of consider-

able magnitude, the latter rather limited as yet on account of its cost.

The *quantity* of heat necessary to produce a brilliant light is so small that notwithstanding all the losses and disadvantages of converting heat into and reconverting it into heat, there is still ample left to give off light in quality and quantity sufficient to compete and supersede all rivals. I may have overstated the case, if viewed from a commercial standpoint only, for gas light still maintains its footing on account of its apparent lower price, and the still further attempt to cheapen its production by substituting carbonized water-gas for the coal gas may perhaps prolong its life a little longer, or it may, like unsuitable medicine, hasten its demise.

For my own part, I fail to see the advantage of water-gas for illumination, setting aside its cost of production. The composition of water-gas, pure and simple, would be two volumes of hydrogen and one volume of oxygen gas, but the mongrel water-gas made by passing steam through incandescent carbon, is practically hydrogen and carbonic-oxide gases in equal volumes.

Now, it is well known that neither of these gases are illuminants; they both burn with a blue flame, giving off very little light, but they give off much heat. Either gas may, with proper appliances, be made to give out heat of such intensity that highly refractory substances subjected to their heat become as incandescent as an arc light; in fact, such is the intensity of the light that workmen who are well accustomed to looking at highly-heated substances can not look into an open-hearth steel-melting furnace without protecting their eyes with blue glasses, from the fierce glare of the interior of such a furnace. So far, I have been unable to detect any difference in the quality and intensity of this light, and the arc light; in my opinion, it far exceeds the intensity of the ordinary incandescent lamps. It is of the same tint as the arc light, and would, no doubt, act similarly on photographic sensitized plate. This I have not yet tested, but shall avail myself of the opportunity when it presents itself.

The flame from the Bessemer convertor during the latter portion of the flow gives a similar light, but lacking in brightness; this flame, I also think, posesses actinic properties; and this I also propose to investigate next time I am in the vicinity of Bessemer Steel Works.

We are all familiar with the light from a smithy fire and have been temporarily blinded by its glare, but how many of us have been struck with it as a source of intense light as well as intense heat? Light is not in this case a desired factor, except so far as it enables the smith to judge of the temperature of the article under operation, for by the intensity of the light it gives off he measures its heat. His thermometric scale is graduated for two of his five senses, touch and sight; his zero is the temperature of the article on his shop floor before being put in his fire; his first gradations are determined by his sense of touch, or feeling, and rises somewhat after this fashion: Zero, or cold, warm, very warm, hot, and up through a series of "black hots," until the heat is just visible, as a very dull red heat; from this point up he uses his sense of sight and goes up a scale of reds—arbitrary, of course—merging into the scale of orange and yellows which brighten up aud fade off into a few degrees of white; an intense white or welding heat completes the scale for all practical purposes.

Looking the matter over in this way and giving rein to our reflective faculties, we perceive the universal prevalence of insensibly associating light and heat, and yet, so far as I am aware, there has been no attempt to render carbon intensely incandescent for lighting purposes, except by electricity. Carbon seems to me to be the element eminently fitted for this purpose, apart from its indispensable role in electric lighting.

(TO BE CONTINUED.)

GRAVEL ROADS.

By Geo. B. Fleece, C. E.

The supposition is that the country road will be built of broken stone or gravel, these being the best, or certainly as good as country districts require and can afford.

As to the material, stone and gravel, the value of these relatively should be determined by the special peculiarities of each and their relative cost. Generally, broken stone is the best, yet there are varieties of gravel better than any quality of broken stone.

Taking limestone as the standard for macadam, any gravel of greater uniformity of size, hardness of substance and smaller dimensions is a better material for roads. When gravel is angular in shape, hard like flint and of uniform size, of, say, the size of a pea to that of a pigeon egg, it will form a road-bed hard, compact and durable, and almost absolutely water-tight, and become, under the settling and compacting influence of travel and time, a homogeneous mass, solid, smooth of surface and capable of bearing without sinking or cutting the heaviest loads; and this until it is worn down to a thickness of three inches, or even less. But to insure this, it should be treated as follows:

The earth's surface should be smooth, dry and compact, and settled to what may be called a final repose; time, rain, travel and rolling will accelerate this, the most favorable condition for receiving gravel; but in practice, it will not generally be found practicable to await such conditions.

However, avoiding a muddy and rough or even surface, it will generally answer every important requirement to begin graveling on a smooth and dry surface, hard enough to hold up, without cutting, loaded gravel wagons of four-inch tread on tire.

The earth's surface being slightly rounded up to a crown of about four inches, the gravel should be spread with a vertical depth of eight inches loose at the center, diminishing to three inches depth at the sides, the surface being left a flattened vertical curve, the width of gravel being twenty feet for a twenty-four foot earth grade and fourteen feet for an eighteen foot earth grade. This should be rolled with an iron roller six feet long of 8,000 pounds weight, with three cylinders of four feet diameter, each working freely and independently on one axle, beginning on the sides and finishing in the center, and repeating in sections as long as possible, as many times as may be necessary to secure a perfectly smooth surface of the utmost solidity obtainable under such a process. A heavier roller will heave up a mass of loose gravel in front and will not answer.

After the rolling, travel may be admitted, but this should be followed by a regular system of surfacing, thus retaining the designed form of a road-bed until the surface becomes smooth and fixed.

Generally this condition of superficial smoothness and solidity is attainable in a few days, the length of time being varied by the quality of gravel, amount and character of travel and the kind of weather.

Gravel, with a slight admixture of coarse sand or iron deposits, will settle promptly, and in some cases concrete to the solidity of stone.

But any species of gravel with the aid of dry sand or clay will, under travel, find final repose and become compact—almost water-tight—and hard and stiff enough to resist abrasion or sinking under the heaviest wagon travel. This might be assumed theoretically, and is absolutely demonstrated on forty miles of gravel road under my personal supervision in the last six years.

Such a road, whether constructed of broken stone of a size that will pass through a one and one-half inch ring or less, or of gravel, may be called the standard country road, and while it has no greater original stability than the Telford road, is nevertheless better and much cheaper for the following reasons:

1st. The gravel or broken stone covering will not sink into the subjacent earth by its own weight, nor is it so liable to sink as it would be if the bottom, or so-called foundation, were rubble stone, as in the case of the Telford pavement, for the gravel bed, after becoming compact, arches the subjacent earth-bed, making a natural homogeneous bond with it, and its weight, together with its load, is borne mainly by the arch crowning, and gravitation downward is arrested by the distribution of the weight over the entire surface.

It is not true, as theoretically assumed, that the weight is "transmitted from the point of contact downward in the line of a

cone, the base of which is to the apex as the square of the vertical depth," for while this is true of a weight of force, all of which is extended on the bottom, it is not true in the case under consideration, for the weight of force is arrested by the bond of the mass through which the force must act; so that the weight of force superimposed must crush through the compacted and interwoven integument of the mass before its direct influence is felt within the theoretical area of its natural spread. The weight that is transmitted through the gravel superstructure must first crush through the top crust. As long as the surface stands intact the bottom is unaffected. Therefore, if the superstructure of a compacted gravel or broken stone bed will not sink or break through and disrupt the bond, there is no need of a foundation of stone under it, except for drainage; for it would but rest there, inert and useless, until such a superficial disruption should occur, and this will not occur as long as the gravel bed resting on an earth base shall be of more than three inches in thickness, as has been demonstrated to my perfect satisfaction, after knowing the results of travel on such roads for more than thirty years, and particularly on forty miles of such road-bed built under my personal supervision.

I state it with perfect confidence that there is not a known instance of a wagon, loaded less than 8,000 pounds weight, cutting through or disrupting the bed and bond of a properly constructed gravel or broken stone road of any compacted thickness exceeding three inches in depth, if properly drained.

Again, if such a road-bed will not sink or disrupt under heavy travel, it must be all that is necessary to meet the end of sufficient stability.

But it may be proposed to compound the structure, making the base or so called foundation of rubble stone, with the fine material on top, as the Telford.

To this there are serious objections:

First, the surface section should be as deep as in the case of an earth base, for it is upon the integrity of the bond that we must rely for stability, and this bond can not be effected in homogeneous and interwoven bed without a homogeneous mass, so that when there is a top gravel bed and a bottom rubble stone bed, the bond is broken at their line of contact. If the top be not strong and self-supporting, the natural and inevitable result will be a grinding force active along the line of contact, or line of change of material, the process of grinding and wearing of the surface and at the gravel bottom, together with the disruptive effects of pounding between opposing forces, resulting in rapid ruin of the upper or gravel covering.

This result, naturally enough to be foreseen, has followed the Telford plan in sections of road built under my personal supervision, and the only remedy I have found has been to reconstruct, tearing up and removing the rubble, regrading and covering with broken stone or gravel.

But it is claimed that a substratum of rubble stone is necessary as a foundation for the gravel or broken stone superstructure. To this I reply that the graded earth surface is a suitable and sufficient foundation in all but an occasional, exceptional case, to-wit: In soft material approaching the fluid state.

In such a case the remedy is to remove it down to a solid bed, in which broken stone or gravel will not sink, and this point is obtained in a material in which rubble stone will sink. After the removal of mud in a semi-fluid state, fill up to the surface with gravel, or, if the material be very deep, drain it and build on the retained earth; or, if this be impracticable, use plank for the bottom, or bridge over. In any case in which a coating of gravel will sink, rubble stone will sink also and much sooner, the one gravitating as a homogeneous mass distributed over the full width of the surface, the other as individual stones, each gravitating with its individual and unbonded weight.

Again, when a macadam road begins to wear, and at any stage of superficial wearing, it may be restored to grade by a fresh coating of the same material, which, if the precaution be taken of loosening up the worn surface after the removal of mud or earth deposits, will adhere and combine with the mass, restoring in a short time the original, perfect and homogeneous bond—a bond which is impossible between two materials, the one in large masses and the other in the form of gravel or broken stone.

It will be observed (from the hypothetical, sectional diagram, not produced) that whatever be the cost of the section on top, which represents the macadam, the whole of the macadam is less than half of the Telford in quantity and cost of construction. In practice I have encountered a serious difficulty in constructing the Telford road, which does not occur in the macadam.

First.—A trench must be dug to receive the rubble stone, of say eight inches depth after the road earth has been formed. If in cuts, the earth excavated must be carted out of the way. And it is worth while to suggest that the trench itself is seriously objectionable for two important reasons; the one that it is generally softer than the surface, liable to fill with water before the stone can be laid, and even then it becomes in its relation to its surroundings an artificial water basin.

Second.—If no trench is formed, and the rubble stone is laid on the graded surface, it runs the road-bed so high above the original earth grade that fresh earth must be added to the slopes and sides, so as to afford a safe margin of earth at the level of travel, otherwise the metal bed will be sixteen inches higher than the earth bank, and wagons must keep a safe distance from the edge or run the risk of turning over.

So it must be accepted as true, theoretically and practically, that the generally received doctrine that a rubble stone bottom is necessary as a foundation is an error, and when it is admitted that it more than doubles the cost of a standard macadam road, and seriously accelerates the wear and disruption of it, there remains no apology for its adoption.

We suppose that the macadam road has been adopted and finished and worn to a smooth surface. Its maintenance is easy, simple, and of trifling expense.

The best plan is to deposit, during construction, a twelve months' supply of gravel or broken stone at convenient points along the road, at about 1,000 feet apart. After every heavy rain send a gravel wagon with about five men, and have the sinks or ruts filled up and ditches reopened and culverts opened, if closed or gorged, and such other amendations made as circumstances may require.

I have found that macadam roads properly constructed, the cost of maintenance is less than one per cent. of the original cost per annum. All this is under the supposition that the system remains under the supervision of a competent engineer or road supervisor, who gives it proper attention,

It is important to protect earth embankments from washing. This may be done cheaply and permanently by sodding to quick-growing heavy sodding grass at the proper season for sowing. Effectual regulation by law of the tread or width of wagon tires in their relation to maximum loads, is a measure second in importance for cheapening construction and reducing the cost of maintenance.

A rule may be safely adopted which would insure public roads against the main destroying agency to which they are subject, to wit, heavy loads on narrow tires. The limit of loads should be 400 pounds to the inch width of tire, and when loads must be exceptionally great, say over 10,000 pounds, they should be drawn on rollers of proper tread.

Wagons emerging from mud roads bring upon their wheels a large quantity of stiff mud which, falling upon gravel roads, is again lifted upon wheels passing over it, and, being pressed on to the gravel surface, it brings with it, by degrees, coatings of fine gravel, making thus holes in the surface, and these, stripped of the hard, smooth surface, deepen rapidly by the repeated process.

A perfect system of roads would provide against direct wagon communication between mud and improved roads, either by throwing out lateral connections with them of, say 500 feet length, of rough rubble road, or by embracing in the system designed every road within it.

If mud roads could be abolished, the macadam road would meet every requirement of a first-class road for any purpose, save that alone of the heaviest city travel.

It is not necessary nor advisable to attempt to maintain by constant thin deposits of new material the original form and depth of road surface, for such thin deposits are soon ground into powder and blown away. But the plan of maintenance should be first to fill ruts and sinks as they appear, filling full and a little above the general surface—this is to be kept up from year to year until the general surface has worn so thin as to show the thickness by occasional disruption of the bond. When this occurs, the original surface and depth should be restored fully by a new distribution of material over the whole road. How often this treatment will be required will depend upon the wearing quality of material and the amount and character of travel. On roads constructed six years ago, under my supervision, part of broken limestone and part of gravel, I can not observe any appreciable depth of wear or other indication of failure.

TRINIDAD LAKE AND LAND PITCH.

By Julius Schubert.

[Continued from April number.]

THE claim that the two per cent. less bitumen shows a great inferiority of the so-called "overflow" is very effectually disposed of by the very clear-headed decision of Judge Allen, of Denver, of which I give an abstract below:

Now the testimony of Prof. Bowen is, that the asphaltum of the Trinidad lake proper contains fifty-five per cent. of bitumen, and that the bitumen is a hydro-carbon in its purity. He says that bitumen is a primitive element by itself; he says that that is the pure asphalt that is spoken of, and he says that the asphaltum that comes from the land adjoining contains fifty-three per cent. of bitumen; one is fifty-five per cent. purity, and the other fifty-three per cent. purity; that, he says, is the chemical analysis. Now, in my experience, I feel safe in saying that when a chemist only makes two per cent. difference in purity, he is showing that it is substantially the same thing; that when he can only determine two per cent. difference in purity he is in an uncertain line of investigation, and science proves it everywhere; they can not say that they are absolutely correct.

Mr. Brown: But, if your Honor pleases, you do not ignore that part of his testimony where he says, that while that is true, there is a quality which is possessed, and which could not be capable of analysis, in favor of the lake asphalt over the land asphalt.

The Court: There is no use of placing any particular stress upon that suggestion, when we have learned that it simply means 55 and 53 per cent. of pure bitumen. What he adds, with reference to the matter, after he said that, to my mind means nothing. He says it is a primitive element. He says it is pure hydro-carbon, 53 in one and 55 in the other, and to my mind, to say that each in its purity is yet different does not mean anything. So I can only say that which he says, that there is two per cent. difference. Now, if there is two per cent. difference, I do not see why, by adding the other elements and ingredients which are required to be put in this cement and pavement, to the extent of making up for the two per cent. of adding a little more of the asphaltum of the 53 per cent. than you would where you use 55 per cent. asphaltum, you would not arrive at the same results.

I notice in this contract that there is room for a variation; in section 36, "Asphaltum cement 13 to 15 parts." There is two parts of variation. "Sand 70 to 83 parts." There is room for a variation. "Pulverized carbonate of lime 4 to 15 parts." There is also room for variation.

Now with reference to the lake: I incline to the opinion that the asphaltum taken from the lands adjoining the lake is substantially the same thing that is taken from the lake itself; so far as the bitumen is concerned it is the same. There is a difference in moisture, but when refined, *if properly refined*, I believe it is the identical same thing. And I believe this from the testimony in this case.

Professor Bowen calls it an overflow, and he thinks that the lake proper, as it now stands, was the mouth of a crater; he thinks that the asphaltum has been thrown up there, and that this asphaltum that appears in the lands around is an overflow.

If he believes that, he believes that after the asphaltum flowed over from the mouth of the crater, in time it has been covered by vegetable matter and earth, by the action of water and otherwise, then he must answer that it comes from what he regards as the Trinidad lake region, not that it came of late, but that it came from the same place sometime, that it was the same thing and is the same thing now unless it has been changed by the action of the elements, or by being deposited in the earth, which would work some change in it, but it can not be changed much when he finds only two per cent. difference in purity. I am inclined to think that this section of the island of Trinidad is underlaid with this asphaltum, and that where this depression is, it is filled and saturated with sea water—salt water—which keeps it moist, and when first taken out it has a different appearance, but when the moisture is freed from it, it appears to me to be *the very same thing*.

Thus said the judge, and one long in the asphalt business could not have spoken and judged better.

Great stress is laid upon the fact that the asphalt in the Pitch lake is softer than the asphalt outside the so-called lake, which latter is called slurringly, "overflow," or "land pitch," and in order to create a wrong impression one is said to be live pitch and the other dead pitch. Of course these are only technical phrases for the purpose of depreciating the value of the asphalt coming from Pitch Point, as life and death can not be attributed to inanimate bodies, but it means to say that by some process of nature the valuable properties of the asphalt have been exhausted. There is an apparent difference in the crude materials; one is softer than the other because the one contains more volatile oils than the other. Nature simply began on the asphalt outside the lake, the the latter being more exposed to the rays of the tropical sun, the process of refining it drove those volatile oils off, which must be, in any case, removed to make the material fit for paving purposes. Consequently a part of the labor of refining has been done on the Pitch Point asphalt, which remains to be done with the Lake asphalt. In the process of refining both asphalts have to be heated to a temperature of at least 350 degrees Fahr., and as the temperature in Trinidad, considering also the heat-absorbing quality of the asphalt, can never heat the material above 150 degrees Fahr., it will be seen that the process of refining is only partially accomplished. It can be proven that whatever the name of Trinidad asphalt as a paving material, it is the same when properly refined.

I have observed the refining of both Pitch lake and Pitch Point asphalts and can prove that the articles produced were exactly the same and that when properly laid they yielded the same good pavements. When improperly refined or laid, they produce equally bad pavements, and I have a number of times found, owing to the more careful refining of the "Pitch Point" asphalt, the percentage of bitumen higher than in the Pitch lake asphalt.

As heated asphalt can't flow any great distance on account of the small amount of latent heat, it is evident, therefore, that where the pitch is dug out from so-called mines which refill, that that refilling can not be from overflowing, but must be caused by subterranean pressure, in which case, the quality of the asphalt, coming from exactly the same subterranean source, must be of the same general character.

The penetration test, frequently used on asphalt cements, I consider very unreliable, owing to the large percentage of mineral matter still remaining in the asphalt.

The only correct way in preparing asphalt paving mixtures is to make sample pavements of different compositions, and to test these samples under the hammer at various temperatures. That composition which stands the best test should be adopted.

A little experience will soon teach what can be done with the materials on hand, and failures will be rare, provided the materials are uniform and care has been taken in the preparation of the mixture and in the laying of the pavement.

Many failures have been made with so-called "Lake asphalt," and still will be made in the future, if greater care is not used in the preparation and laying of it, so that the adoption of the word "Lake asphalt," in the specifications for asphalt pavements in the different cities, will by no means insure a universal success. Contrary, it will do harm, because it will keep out a wholesome competition, which is absolutely necessary for progress.

"OVERFLOW ASPHALT" PAVEMENTS CONDEMNED IN DENVER.

LAST year about 80,000 yards of asphalt paving was laid in Denver by the West Indies Asphalt Paving Company and W. H. James. The board of public works and the city engineer of that city have condemned all of the work. The Denver *Republican* of April 15 contains the following information regarding the condemnation of the work:

This work will have to be replaced with "Pitch Lake" asphalt, as called for in the specifications, instead of overflow material, which was used by this concern. All the work contracted for must be carried out according to the strict letter of the specifications. The contracts let last year to James on account of himself and his company were the paving of Fourteenth, Lawrence, Seventeenth and Eighteenth streets. The intention was to use the overflow material on all this work, but it has been decided after a short practical test that it is not equal to the genuine asphalt. Some of the concrete laid last year will have to be replaced also.

The decision arrived at in reference to the paving was reached after a careful examination of the work by members of the board of public works and the city engineer. On Wednesday evening the city engineer wrote to the board of public works of his decision, and at a meeting of the board yesterday it came to the same conclusion, which sustains the decision of its own engineer last year that overflow asphalt will not wear. The pavement on Seventeenth street, which is in the worst condition, was laid late last fall, and the low temperature so affected it that when the snow was cleared away, leaving it without protection from wheels and hoofs, it scaled and broke in lumps. The other streets paved by the company are also pulverizing.

Following are the preamble and resolution adopted by the board of public works:

WHEREAS, It now appears, after careful investigation by this board, with the assistance of the engineer, after notice to and in presence of the contractor, that the materials used and the work done in constructing the pavements heretofore laid by the contractors on Fourteenth, Lawrence and Seventeenth streets are not in accordance with the requirements of the several contracts therefor; and the doubts and disapproval of this board and the engineer communicated to the contractor before and during the progress of the work as to the sufficiency of said materials and labor have been fully confirmed by the lapse of time, the effects of travel and the deterioration of the work; therefore, be it

Resolved, By the Board of Public Works of the city of Denver, that said pavements and all of them, and the materials and work used in constructing the same, are hereby condemned, and the contractor is hereby ordered at once to remove and relay the entire wearing surface laid on said streets respectively, and each of them to this date, and so much of the concrete foundations as may be found defective when uncovered for examination, and to properly reconstruct the same on each of said streets, and to proceed with the unexecuted portion of the work on each of said streets, and also upon Eighteenth street, in pursuance of the several contracts of said contractor, in all cases using the specific materials and skilled labor provided for in said contracts respectively.

And the president is authorized to cause a copy of this resolution to be served on the contractor. J. E. BATES, President.

The companies whose work was condemned at once addressed a letter of inquiry to the board, to which the following reply was made three days later:

Your inquiries of the 15th instant are at hand. The deterioration and failure of the pavement is so marked in the months since it was laid by you under a five-year guarantee, that certainly, as to much of it, we doubt not you will readily accede to the justice of our demanding an immediate reconstruction; in fact, we understand that you do so accede.

Touching the essential qualifications in which it is lacking, and the extent, we have to say: An investigation, made in your presence, disclosed the apparent worthlessness of some of the hydraulic concrete. The precise nature and extent of this we have not yet fully determined, nor can we, of course, until it is uncovered.

The importance of this defect is much enlarged by reason of the lack of a better covering. It is always more or less uncertain how such work may gain by age. Even under portions of the present surface, where much worn and in bad condition, an uncovering of the concrete disclosed no apparent setting or disturbance in advance of being attacked by a pick. Under a first-class cover much improvement might result in places with age.

Whatever the cause, however, it has deteriorated to worthlessness and should be replaced. We know that desirable results are to be had from precisely similar materials and as yet see no reason to change the materials upon this work.

As to the wearing surface, observation of its manufacture was denied us by you. It is obviously inferior as to toughness and durability; it lacks compaction and shows the use of sand that is too coarse and at times the use of unsuitable oil. These defects extend to all portions of the work in greater or less degree, and we believe the difference in the wear is largely due to the varying travel upon it, that other modifying conditions are minor and that in a comparatively short time it would all fail.

Without regard to fine distinctions shown by chemical analyses or the question as to just how closely the asphalt used by you approaches a given theoretical chemical standard, it has been practically shown to be inferior to that called for in your contract, and we believe it is the chief cause of the failure of the pavement.

You will do us the justice to admit that it met with question and the suspicion of this board and of its engineer and later up to the time of and during its use with their plainly expressed disapproval and condemnation. The material would have received no consideration or use, save under your assurances of entire knowledge, confidence and guarantee which from the first were strong, repeated and unequivocal. We had entire trust in the good faith and sincerity of these assurances and have still.

The field being now limited and much disputed, unfortunately, we could procure no direct or tangible evidence to support our own distrust of the material sufficient to warrant a stoppage of the work in the face of the great public necessity for its continuance, and with considerable street area torn up and concreted, and in the face of your assurance and guarantees, backed as they were by local sureties of unquestioned credit and responsibility. It was upon the faith of these assurances and guarantees only that any payments were made to you upon the work, and you proceeded in the face of our freely expressed distrust and disapproval. To-day the conditions are different, an unexpectedly short practical test has demonstrated that our fears were well founded.

The pavement is a failure, and believing, as we do, that this is owing to the inferiority of the asphaltum used as well as the process employed, we can not permit a further use of the same material. We do not know that the asphalt may not make a pavement approximating that called for in your contract. We are satisfied, however, that it is inferior, and that it requires a different treatment from that called for in your contract. What the difference is we do not know, nor have we assumed to direct. You did assume to know, and upon your responsible assurances you were allowed to go on and illustrate. Had your confidence been well grounded, you would have done the public a great service in establishing the value of a competitive article, whatever were your controlling motives.

It is now plainly evident to us that you were mistaken. We are bound to believe that you proceeded in the best manner known to you, but you failed.

With all due consideration for you, and we think you are deserving of all possible consideration, we must recognize the fact that the next use of this material will be in the way of experiment, undoubtedly, and we do not feel authorized to experiment on this work. The use of this asphalt, coupled with the assertions of positive knowledge and guarantees you originally opposed to our unsubstantiated distrust is one thing; in the light of the present position it would be quite another.

Since failure was to come it is well it came so quickly.

We feel assured that a repetition of it can be easily avoided by the use of a different and tried article of asphalt and the process laid down in your contract, and we do not know any other way.

Yours, etc., JOSEPH E. BATES, President.

THE CHEMISTRY OF PAVING-BRICK MANUFACTURING.

By M. D. Burke, C. E.

THE alkalies of potash in the clays is a residuum of decayed organic matter. It is an active fluxing agent, and in the process of burning, or so-called vitrification, causes an amalgamation of the iron and silica components which imparts a metallic tone or ring to the brick when struck. When aided by finely pulverized lime or magnesia in the presence of a large percentage of iron, a pale double silicate of lime and iron is formed, imparting a buff tint to clays that would otherwise burn red. In the fire-clays less than half of one per cent. of potash or alkali produces no noticeable result, and the product has good heat-resisting qualities, but when from one to three per cent. of this ingredient is found in the clay and it contains from four to eight per cent. of iron, which it generally does, with perceptible quantities of lime and magnesia at a high temperature (usually a white heat), these fluxing components form vitreous combinations with the silica, producing a brick quite useless for resisting heat, but when the texture is uniform throughout, and it is allowed to cool gradually, without coming in contact with cold air until below the temperature of boiling water,

or, in other words, is properly annealed, you have the so-called vitrified brick, which absorbs about two per cent. or less of moisture, and has great strength to resist crushing or abrasion. This product may be used quite fearlessly for street paving.

With the plastic clays or shales the melting or vitrification occurs at a lower temperature, and, owing to the fact that the ingredients are seldom uniformly mingled, there is greater danger of melting the bricks together in the kiln, or of leaving many of them without vitrification. To render them apparently impervious to moisture, many manufacturers have adopted the plan of glazing them with salt, which may be beneficial in some respects, but is objectionable in others. These clays usually contract to a greater extent in the process of drying and burning than the fire-clays do, and hence are more liable to be warped from their proper form, or show injurious fire cracks. But no clay can be made into a good street paving brick, unless the process of firing or burning be continuously progressive and comparatively slow to the maximum temperature, and the cooling down be gradual and continuous. This can not be done in the ordinary clamp kiln. A broken brick showing varieties of texture or color is a certain indication of defective combination or burning, and the fault is fully as liable to be in the burning as elsewhere. Uniformity in the product of the kiln is a necessary condition to the successful manufacture of clay of any kind into proper form to be used for street paving; and only with such clays, and such appliances as will enable the manufacturer to attain this result, can he reasonably hope to achieve success.

CLEANING OF STREETS.

By Louis H. Gibson.

A GOOD street neglected soon becomes a bad street, and a bad street properly cared for soon becomes a good one. It is not so much a question of what kind of a street as it is the care of them. A city which has an organization for caring for streets will, in the nature of things, soon find itself possessed of all facts necessary to decide which is the best kind of street for particular purposes. One of the first things connected with this development is the cleaning of streets. We may not know how good a street is if we do not clean it. We certainly may not know how bad it is, inherently, if it is entirely neglected. It is not always possible to tell what kind of a street one is traveling over by looking at it. In many cities there are brick streets, asphalt, wood, macadam, and others which are not to be distiguished by external appearances. We are told that a certain street is of brick. Looking at it is not ocular proof. This is not right. It does not do justice to the man who built the street, nor again, to the citizens who pay for it. There are in every city in America streets of this kind. There are also those which have passed into a state of apparent decay, which, if cleaned, relieved of superfluous mud and cared for persistently, for a short time, would soon become good. Any one who cares to investigate this subject in his own city, or town, will notice streets muddy or dusty, those with ruts in them, and particularly so in the case of gravel or macadam, if neglected. The removal of the dust or mud from these streets shows exactly where the fault lies. The application of broken stone or gravel, hammered down into the low spots will soon bring this street to a condition which will yield good service and great comfort, and all without great expense. These results are only derived economically by street cleaning. Street cleaning should come before street building. Certainly street cleaning should come before street sprinkling. Many a good street has been torn up and replaced merely because it showed bad in spots. The cleaning of that street would have shown the particular spots, the inherent weakness, and at the same time the absolutely good qualities. No one knows how absolutely bad, or how absolutely good, a street covering is unless it is clean. To a certain extent the dirt covers the bad and the good. It covers certain faults and exaggerates in some places the weakness.

ECONOMIC VALUE OF GOOD ROADS.

THE Hon. Clem Studebaker, of South Bend, Ind., recently addressed a farmers' institute in his city on the subject of country roads, in the course of which he said:

"Economically considered, good roads are a vast improvement over bad roads to all who have anything to do with them. I can not stop to quote the figures to you. I simply say in a general way that they are staggering. I could cite you the statistics that would convince you thoroughly, if this were needed, but they would make you nearly as tired as to ride over that stretch of bad road referred to a little ways back. Periodic bad roads, to a certain extent, shut the community away from the rest of the world. Whatever shuts up a neighborhood from the outside, turns away capital from that locality. Fifty people will want to buy a farm on a good road to one who will take under consideration the purchase of property on a poor road. This means an active demand for farming lands on the one, and a dull, or lifeless market, for the acres lying along the other. Distance from the town or city where the produce is sold and the supplies are bought, has something to do with the desirability of farming property, but the influence of good or bad roads on the price of such property is vastly more potent. A farm that you would be obliged to reach by swimming the St. Joseph river would not be worth much to you, and the public puts about the same value on a farm at the other end of roads that during a portion of the year are hub deep with mud or ruts. It is safe to say that hundreds of farms in St. Joseph county would easily be worth double their present market value if they were connected with South Bend by a hard, smooth road, with easy grades, and I believe that I speak within bounds in declaring that in the rise of values alone every dollar judiciously expended in durable road-making would be returned to the community investing in such a highway, four-fold. There are no keener men in the world for turning an honest penny than those who make a business of buying suburban property from which to form additions to cut up into lots to put upon the market. I have to some extent in various parts of the country watched their methods in thus bringing property into the market, and those who are most successful invariably, as a preliminary to creating a demand for these new lots, connect them with the leading streets of the town or city to which they are contiguous, by a durable, smooth and handsome thoroughfare. In Washington, which boasts the finest streets in the country, the first move made is to open streets into the new platted property, and cover them with a pavement of concrete and asphalt. Property thus favorably introduced to the attention of the public, often sells like wildfire. In the southern towns, like Dallas, Fort Worth, San Antonio and Huston, etc., and in Denver, Los Angeles, and other cities where suburban property has been sold off at high prices and built up with handsome residences, in every case these suburbs will be found to be connected with their respective cities by elegantly finished roadbeds. Without these, indeed, the suburbs would never have been built, at least they would never have settled up except by a class of property owners with limited means, who would find the chief attraction of purchase in a low price for the lots. Have you a farm on a soft dirt road, unfit for travel for from one to three months of each year, which you would like to increase in value from 25 to 100 per cent.? Join with your neighbors in improving the road. Make it one of the best in the county leading from your farm to South Bend, and I am no prophet if you will not bless the day of your good roads, not only by reason of the increase in the marketable value of your farm, but in the saving of the expense incurred in the delivery of your farm products to town, and the added comfort which you will experience in visiting the city on business or pleasure.

"To my mind the government, state and national, might with entire propriety, give material aid in the building of public highways. This was the doctrine of Henry Clay, and it is as good doctrine now as it was in his time. Government dollars might often be much better spent in the improvement of the roads that in deepening harbors or making creeks navigable as rivers."

BRICK PAVEMENTS IN HOLLAND.

By Louis H. Gibson.

IF one wishes to go back into the history of the brick pavement, let him go into Holland. Brick is used there in many instances because it is the local material most readily secured. The thoroughness, the honesty, the cleanliness of the Dutch have led them to give the brick pavement a splendid test, than which the results could not be more satisfactory. After traveling over the brick roadways and pavements of Holland it is difficult to meet with anything more satisfactory. The readiness with which such a pavement may be cleaned, its fitness for the comfort of the horses which travel over it, its famous history for stability, all tend to proclaim it an admirable and almost ideal covering. Long history and severe tests in Holland present to the advocates of this pavement the best evidence of its permanency and generally satisfactory character.

HOW TO DISPOSE OF SEWAGE.

THE Sewage Problem in Baltimore" was the subject of an address by Dr. C. W. Chancellor, secretary of the Maryland State Board of Health, before the Taxpayers' Association of that city recently. While local in its application, it is of general interest:

"If the cesspool system should be abolished in Baltimore, as a proper regard for the future health of the community demands and surface drainage continued with sewers for storm-water only in low-lying areas, which is strongly to be advised, then a special plan of disposal devoted exclusively to sanitation must be adopted. In this we have to deal with conditions which are constant and uniform and within the range of easy calculation. Any process of disposal which fills the measure of sanitary requirement, and at the same time restores the barren and impoverished soil to a healthful and attractive fertility as the result of such operation, would be the *ne plus ultra* of a sewerage system.

"The water carriage plan of 'all to the sewer' is the worst method of sewage disposal that could be adopted, and yet it is almost universally resorted to on account of its apparent convenience. Such a system in Baltimore would be an expensive and fatal blunder. In the first place, storm-water drains receiving excremental matters become so many large retorts circulating through the town for the production and distribution of poisonous gases and germs of disease. In the next place, the ultimate disposal of the noxious matter after it is out of the city is a question which has not been settled either to the interests of agriculture or the laws of hygiene. Using rivers and water-ways as receptacles for some kinds of sewage was at first tolerated on the assumption that the enormous dilution with water would render the matter inoffensive. This is a fallacy, inasmuch as the solid matters are dissolved only to a very limited extent, and are soon precipitated and deposited on the banks or bottom as a noxious mud, which will soon give rise to odors and dangerous miasms.

"The average volume of sewage discharged from the houses and streets of this city may be roughly estimated at 25,000,000 gallons daily, containing in suspension more than fifty tons of putrescible solid matter. The evil effect of such a large volume of putrescent matter in the river or bay can hardly be overestimated. The clothing of the banks with sewage mud and the mass of gelatinous matter which would accumulate on the shoals of the bay would certainly prove destructive to fish and oysters, as well as to the health of persons residing in the neighborhood. In London and Paris, where this system exists in its greatest perfection, the sewers have been found to foul the air to such an extent that some supplementary arrangement is deemed necessary, and propositions to this end are now being discussed. The common sewer has been found to be a common nuisance.

"In Baltimore we are favorably circumstanced as to natural drainage. The contour of the city is such as to give running water a considerable velocity, and this undulating feature should never be interfered with. The practice of leveling the surface of a city is most pernicious. If possible, every street in the city should have a descent of fifteen or twenty degrees, which would tend to give a brisker circulation to both water and air.

"The difficulty connected with the subterranean removal of water after being used for domestic purposes consists chiefly in the suspended solids, such as particles of food and coffee grounds, which form an offensive and tenacious sludge. There is no technical reason why kitchen sinks and other receivers of household water should not be so constructed that most of the suspended matters will be retained by straining or filtering, and can then be taken out of the sink for removal with the dry garbage. The removal and disposal of industrial waste products at the expense of the community is an injustice to every one not participating in the profits of the manufacturer, who should be required to make his own waste liquids inoffensive before they are admitted into any public street, sewer or water-way.

"Irrigation of ordinary arable land with crude sewage has never been successful from the double point of view of avoiding a nuisance and disposing of the sewage at a commercial profit. The land soon becomes sewage-sick, and inefficient as a purifying agent. Sewage irrigation carried on in warm weather is often offensive and unhealthy. Precipitation is somewhat better, but far too expensive to be applied to towns and cities. Rendering household sewage sufficiently clean to be discharged without further treatment into water-ways not used for domestic purposes, or for sub-surface irrigation by straining out the bulk of the solid matter, costs not only less than ordinary irrigation or precipitation, but allows also a great saving in the sewer-nets themselves, which can be applied piecemeal and as they are needed.

"The plan of separating the fluid from the solid parts of household sewage, while the fluids are discharged into the soil or into some water-course in an innocuous condition is very simple. A small portable apparatus may be supplied to each house, provided with a strainer, whereby the water of crude sewage is separated from the solid parts. The hermetically closed receivers, when full, are then to be collected by a properly organized system, as in the case of garbage, and clean ones left in the places of those removed. Sewering a town by this plan would cost far less than by any other efficient and cleanly method, since the sewers or discharge pipes are not only much smaller, but also simpler and less difficult to build. The matter thus collected can be converted into a dry powder valuable enough to pay the cost of the entire process.

"The product obtained holds from eight to ten per cent. of nitrogen, two and one half per cent. of phosphoric acid and three and one-half per cent. of potash, which represents a minimum value of $33 a ton, or $1.50 a person per annum. Against this stands the expense of collecting and drying, which may be estimated at a maximum cost of seventy-five cents a person, leaving a balance of seventy-five cents a person, which, in a city of 50,000 inhabitants, would more than pay the interest on the cost of a plant. At the same time there is an end of all pollution of soil, air, and water. Of course the greater the density of the population the greater will be the net profit. As to what is to be done with the street-sweepings, house-rubbish, and garbage collected, nothing can be better than to burn the whole mass. In properly constructed ovens, a very small amount of fuel, in addition to the combustible matter of the rubbish itself, suffices to effect the purpose, and the ashes are, on account of the minerals and salts contained in them, a fertilizer valuable enough to pay the cost of the entire process."

APPARATUS FOR DETERMINING THE WEAR ON PAVING MATERIALS.

AN apparatus is in use at the German government testing station at Charlottenburg, Berlin, employed to determine the wear on paving and flooring materials, which, as described in the "Zeitschrift fuer Transportwesen und Strassenbau," consists in substance of a horizontal cast iron disk of about thirty-one inches diameter, which, driven by a bevel gear, makes twenty-two revolu-

tions per minute. The revolutions are registered by an apparatus in connection with it, which strikes a gong at the completion of each twenty-second revolution. Then three-fourths ounce of Naxos powdered pumice is spread on the disk immediately in front of the testing piece in such a way that the whole amount of powder must pass the sample. This is pressed against the disk by a one-armed lever weighted with sixty-six pounds, so that a smooth surface of nearly eight square inches is exposed to the grinding process. After 110 revolutions are completed, motion is suspended, and the previously weighed testing piece, after being carefully dusted with a brush, is weighed over again. This process is repeated four times. Then the sum of the different losses by wear, divided by the specific weight of the respective material, will give the amount of wear in cubic centimeters.

ASPHALT PAVING EXPERIMENTS IN NEW YORK.

THE report of the commissioners of public works of New York upon the extent and condition of the asphalt pavements laid in that city under the act of 1889 authorizing experiments to be made with that style of pavement, states that portions of sixty-four streets have been paved, of which fifty-six have needed no repairs, four have been repaved, and four have been rejected for poor work and material. Three qualities have been used—the Pitch Lake asphalt from Trinidad, the overflow deposits on the same island, and the natural rock asphalt of Europe, and a comparison of their wearing qualities leads the commissioner to express the conviction that the Pitch Lake asphalt of Trinidad is the only one that will stand the climate and wear, and he recommends that no other kind be used in future.

MUNICIPAL ENGINEERING IN CHATTANOOGA.

AT the April meeting of the Engineering Association of the South, held in Nashville, a paper by Mr. James A. Farleigh of Chattanooga, on "Municipal Engineering in Chattanooga," was read. The paper presented the system of organization and control of the department of public works and engineering of the city, giving also the amounts of appropriation and expenditures during the last two years, together with the amount of asphalt, granite block, brick, and block asphalt streets in use, with the cost of same and an exhibit of the mileage and cost of the sewers of the city, of which there are nine miles of brick and thirty-three miles of pipe sewers. The paper was discussed by Vice-president F. P. Clute of South Pittsburg, Tenn.; Col. H. M. Robert of Nashville, Tenn., and Mr. Hunter McDonald of Atlanta, Ga.

ECONOMY IN THE REPAIR OF STREETS.

MR. JOHN P. PRICHARD, superintendent of streets of Medford, Mass., in his annual report, just issued, says on the subject of economy in the repair of streets:

"To have good streets it is necessary that they be kept clean, and that the dust and mud be removed and the ruts and hollow places be filled up as fast as they are formed. It may be thought that this is expensive, but the fact is that it costs less per mile of street kept one year than the system of annual repairs, as has been proved the past year. Without continual repairs there can be no such thing as a constantly good street. If they are well maintained and kept in good order, they will cost less than poor streets. Good streets are expensive, but poor streets are much more so."

PUBLIC WORK IN ERIE, PA.

MR. GEORGE PLATT, the city engineer of Erie, Pa., in his annual report, submitted to the city council last month, states that the asphalt paving done there last year cost $74,231.38. The city now has something over seven miles of paved streets, stone and asphalt, which cost $377,832.37. Mr. Platt very pertinently protests against a rule in operation in Erie which allows property owners to make sewer connections in their own way on permission granted by the city, to cut into paved streets and to lay their own sidewalks. All work of this kind should be under the direction of the city engineer.

LEGAL DECISIONS.

Interpretation of Contract and Bond for Construction of Water works.—A city passed an ordinance authorizing a certain firm to construct water-works for it upon terms fully set out. This was accepted by the firm and a memorandum of the acceptance was attached to a copy of the ordinance and signed in behalf of the city by the mayor and clerk thereof, under its corporate seal, and by the firm and each member thereof under their individual seals. This constituted a binding contract. The firm gave a bond which, after reciting that the same was required of them by the city "for the faithful performance of their contract," expressed the condition to be that they should faithfully perform their contract "during the construction of said works." The latter words did not restrict the scope of the bond to the period of actual construction, but, on the contrary, a failure to begin the work at all constituted a breach. The amount of damages was at least equal to the difference between the contract price and the compensation provided for in a new contract made in pursuance of a bid, secured by a subsequent advertisement of the same work. *City of Goldsboro* v. *Moffette*, U. S. Circ. Ct., N. C., 49 Fed. Rep. 13.

Evidence of Surveyors as to Boundaries.—Where the location of the dividing line between the parties litigant is relevant to the matter in controversy, the testimony of the county surveyor that he ran the line pending the suit, that defendant was present when this was done, and that a certain map of the survey is correct, is admissible evidence for the plaintiff, notwithstanding the surveyor also testifies that his work was done in the processioning the land in accordance with the statute on that subject. That the surveyor obtained his information as to the true location of the line while engaged in processioning the tract will not affect the admissibility of the evidence. The plot was admissible to illustrate the evidence of the witness, and if the accompanying report of the processioners corresponded with this evidence, and with the plot, it was harmless; and, if it differed from the same, the contents should have been set out in the bill of exceptions. *Green* v. *Harris*, Sup. Ct. Ga., 14 S. E. Rep. 593.

BRIDGES AMONG THE CHINESE.

THE most remarkable evidence of the mechanical science and skill of the Chinese at an early period is to be found in their suspended bridges, the invention of which is assigned to the Han dynasty. According to the concurrent testimony of their historical and geographichal writers, Sangleang, the commander of the army Kaoutsoo, the first of the Hans, undertook and completed the formation of roads through the mountainous province of Shenshi to the west of the capital. Hitherto its lofty hills and deep valleys had rendered a communication difficult and circuitous. With a body of 100,000 laborers he cut passages over the mountains, throwing the removed soil into the valleys, and where this was not sufficient to raise the road to the required height he constructed bridges which rested on pillars or abutments. In another place he conceived and accomplished the daring project of suspending a bridge from one mountain to another across a deep chasm. These bridges, which are called by the Chinese writers very appropriately, flying bridges, and are numerous at the present day, are sometimes so high that they can not be traversed without alarm. One still existing in Shenshi stretched four hundred feet from mountain to mountain, over a chasm five hundred feet. Most of these flying bridges are so wide that four horsemen can ride on them abreast, and balustrades are placed on each side to protect travelers. It is by no means improbable (as M. Pauthier suggests) that as the missionaries to China made known the fact more than a century and a half ago that the Chinese had suspended bridges and that many of them were made from iron, the hint may have been taken from these for similar constructions by European engineers.—*Scientific Press.*

Improvement and Contracting News.

PAVING.

Ithaca, Mich., is agitating paved streets.

Street paving is being talked at Fargo, Minn.

Atlantic, Iowa, talks of paving her streets.

Anderson, Ind., will pave several streets with brick.

There is talk of paving the streets of St. Cloud, Minn.

Some street improvements are to be made at Danville, Ky.

Maple avenue at Evanston, Ill., will be paved with cedar blocks.

Burlington, Ia., is getting ready for more brick paving this season.

The new council proposes to have better streets for Defiance, Ohio.

Barnesville, Ohio, talks of laying a mile of street paving this year.

Fort Dodge, Ia., is seriously considering the matter of street paving.

The paving and sewerage questions are being agitated at Creston, O.

More street paving will be done at Martin's Ferry, Ohio, this season.

Bids are asked until May 21st for grading one street in Mansfield, Ohio.

The $70,000 boulevard is in process of construction at Santa Barbara, Cal.

A vitrified brick pavement has been laid on E street at San Bernardino, Cal.

The remainder of Detroit's (Mich.) boulevard system will be paved this year.

The trustees have voted to pave Broadway with granite blocks at Greenbush, N. Y.

Oregon and Washington streets, at Oshkosh, Wis., are being paved with cedar blocks.

Contracts have been let for over two miles of street paving to be done at Clinton, Iowa.

Court Square, at Memphis, Tenn., will be paved by the Tennessee and Miller Paving Companies.

The Legislature passed a law granting New Lisbon, Ohio, the right to pave Washington street.

The board of works at Newark, N. J., has authority to spend $500,000 in street improvements.

Dallas, Ore., will grade and gravel Main street, and the work will be completed as soon as possible.

A large amount of brick paving and macadamizing is to be done at Ithaca, N. Y., this year.

The Barber Asphalt Company has been awarded two large contracts for street paving at Buffalo, N. Y.

Atlanta, Ga., is to have a boulevard from the heart of North Atlanta to the new water-works reservoir.

Des Moines, Iowa, has contracts let for eight miles of brick paving, ten miles of cement curbing, two miles of five-ft. sewers, six-miles of 15 to 24-in. pipe sewers, and one bridge for $35,000, for this season.

Several thousand feet of paving will be laid in the business part of the city of Monmouth, Ill., this year.

At Chattanooga, Tenn, Sixth street is now paved from Chestnut to Cypress and for some distance above it.

Summer street at Nashville, Tenn., will be paved with granite at a cost of $2.29 per square yard by J. B. Diver.

A Belgian block pavement is to be laid on King street from Market to Tenth streets, at Chattanooga, Tenn.

The question of paving the principal streets with vitrified brick at Roanoke, Va., is receiving consideration.

C. B. Garrett & Co. have a contract for 2,000 feet of paving on Eighth avenue, east of Beattie street, Helena, Mont.

An act of the last legislature provides for the issue of $60,000 worth of bonds for street improvement at Hagerstown, Md.

Street improvements are being carried on in every part of the city where contracts were not completed last fall at Duluth, Minn.

At a town meeting of Streator, Ill., $1,000 was appropriated for tiling roads and $1,000 for macadamizing North Bloomington street.

At Sunnyside, Ore., Laburnum avenue is to be improved by grading and laying sidewalks from Hawthorne avenue to the Base Line road.

George Kreichbaum & Co. have a large paving brick contract for this season at Keokuk, Ia. It will amount to thirty or forty thousand dollars.

The property owners on Lafayette street, Ottawa, Ill., are agitating the feasibility of curbing that street and also paving the same with cedar blocks.

It will cost $3,800 to grade Bridgeport avenue at Spokane, Wash. The contract was awarded to Peter Costello for $3,800 by the board of public works.

The question of paving Main street at Lima, Ohio, is receiving consideration, some of the most ardent advocates being extensive property owners.

The American Fire Clay Company of Toronto, Ohio, received the contract to furnish 1,600,000 paving brick for Louisville, Ky., at $13 per thousand.

The council of East Oakland, Cal., has been asked to order the macadamizing of Monroe street, from Twenty-third avenue to the east boundary of the city.

The city aldermen of Sioux Falls, S. D., have ordered twenty-two blocks of paving laid this year. Sioux Falls to-day possesses only seven blocks of paving.

Quite a number of streets at Hackensack, N. J., are to be macadamized this year, for the payment of which bonds to the amount of $35,000 will be issued.

David Turner was awarded the contract for paving National avenue from Fifteenth to Washington avenues, at Milwaukee, Wis. He will pave the street with cedar blocks.

The sum of $6,000 was transferred for the purpose of widening Summer street from Maple to Pleasant streets and to widen Maple street from Summer to Cedar streets at Malden, Mass.

A bill pending in the New York Legislature provides for a state loan of $10,000,000 for the construction and maintenance of country roads outside of towns and villages.

Edward Ryan has a $450,000 contract on hand to improve the streets of Dayton, O., with brick. The authorities adopted the Porter light colored brick manufactured at Wheeling, W. Va.

Work has been started on the reparing and regulating of Dorchester avenue, Boston, Mass., for which the city has appropriated $120,000. It will take three or four months to complete the work.

The board of estimates and apportionment authorized the expenditure of $1,000,000 of the $1,500,000 authorized by the Legislature to be expended during the year for repaving streets at New York.

Allan & Vieths have received two contracts for reconstruction with granite blocks Pestalozzi street from Ninth to Thirteenth streets at $11,077, and Ninth from Arsenal to Pestalozzi streets at $7,729, at St. Louis, Mo.

Governor Flower has signed Assemblyman Well's repavement bill. It provides for the issuance of $200,000 of bonds and the repavement of Third avenue from Harlem river to 170th street, at Harlem, N. Y.

The Rockford Construction Company's bid on a paving contract at Davenport, Iowa, was $74,963.97, and was awarded the same. Paving $1.37 per yard, curbing 50 cents per foot and excavating 30 cents per yard.

Twenty-five miles of streets and avenues in the Capitol Hill District of Denver, Col., are to be paved under the district improvement act. The cost of the proposed work will reach $1,500,000 at the very lowest estimate.

The board of public works hopes to see Broadway, Philadelphia, Pa., paved with asphalt before the close of the season. It is 13 miles in length from League Island to the Montgomery county line and a uniform width of 113 feet.

At the close of the present season, with Market, Tuscarawas and South Cleveland avenues, added to the streets already paved, no city in the state of Ohio, can point to improvements in that line with more cause for just pride than Canton, Ohio.

The Warren-Scharf Asphalt Company will surface Eighteenth street from Town to Rich streets with asphalt at Columbus, O. The people are also agitating the improvement of East Tompkins street, the main thoroughfare to the east from High street.

Canal street, from First avenue, to Muskegon avenue, Minneapolis, Minn., will be paved with limestone. Some of the property owners along the thoroughfare wanted cedar blocks, but the board of public works refused to recommend anything but stone.

Two additional streets are to be paved with granite at Buffalo, N. Y. Spencer street, from Montgomery street to Water street, by Henry Dumary at a bid of $2,938.90, and Montgomery street, from Steuben street to Spencer street, by R. H. Strong, at a bid of $11,686.64.

The project of building new stone roads in Chester township, Burlington county, N. J., is assuming definite shape. An engineer has been engaged to take charge of the matter, and preliminary surveys are being made. It is proposed to build twelve miles the coming summer, the available funds being $43,000.

An ordinance establishing a curb line on all streets in the city of Wymore, Neb., prescribing the distances to be observed between property lines and sidewalks in the laying of the latter; providing regulations for the planting and growing of shade trees, and to establish a penalty for noncompliance with provisions of same, has become a law.

North Limestone street from the north line of Main street, to the south line of McCreight avenue; South Fountain avenue from a point 36 feet north of the south line of Washington avenue to the south line of Jefferson street, and High street from the west line of Center street to the west line of Yellow Spring street at Springfield, Ohio, are to be paved this season.

A grand boulevard will be built from Louisville, Ky., to Jacob Park; three miles long, forty feet wide, will cost $49,000 and be finished by the middle of October. G. W. Gosnell, who was awarded the contract by the Park commissioners, will construct it with an 8-in. broken stone foundation, put down in two courses of 5 and 3-in. layers. On this foundation will be spread a 4-in. layer of the very best Paducah gravel and rolled with a five-ton roller.

SEWERS.

Sewers are to be built in South Berkley, Cal.

Stanwood, Iowa, is to have a sewerage system.

A sewer system will be established at Middleport, Ohio.

Red Bank, N. J., will sewer her streets and then pave them.

Bonds have been sold for a sewerage system at Woodland, Cal.

A large number of sewers is being constructed at Albina, Ore.

About six miles of sewers are to be built at Quincy, Ill., this season.

Palestine, Tex., is discussing a system of sewerage for that place.

A system of sewers will be built at Red Jacket, Mich., this season.

An extensive sewerage system is being put in at Missoula, Mont.

Twelve thousand dollars will be spent for sewers at Bridgeport, O.

Seattle, Wash., is putting in a sewerage system to cost over $500,000.

The estimated cost of a proposed sewer at Sunbury, Pa., is about $20,000.

Thirty thousand dollars worth of sewer bonds have been sold at Waco, Tex.

Minneapolis, Minn., will use 1,000,000 bricks in sewer construction this year.

Another $200,000 was voted to finish the O. K. Creek sewer at Kansas City, Mo.

Contractor Kirkland has a contract for building a sewer in Ishpeming, Mich.

The plans and specifications for the new sewer in Park street, Alameda, Cal., were adopted and the work ordered.

Plans are being prepared for extending the sewerage system at Palouse, Wash.

A thirty inch brick sewer will be built on North Main street at Pawtucket, R. I.

Contracts have been let for about $100,000 worth of new sewers at Milwaukee, Wis.

Three thousand feet of 12, 15 and 20-inch pipe sewers will be built at Poughkeepsie, N. Y.

The board of control has prepared plans for sewers in seven streets at Cleveland, Ohio.

The committee on sewers at Montreal, Que., has voted to construct sewers in three streets.

Perth Amboy, N. J., is to have a new sewerage system, for which plans are being prepared.

Work has begun on the new sewerage system at Whatcom, Wash. Local parties will do the work.

Philadelphia, Pa., will build sewers in about forty streets, including sixteen sewers in Frankford.

H. C. Kingman received the contract for furnishing additional sewer pipe for South Framingham, Mass.

The city of Johnstown, Pa., has voted to construct a sewer in ward five, and also to extend other sewers.

A movement is on foot favoring the introduction of a sewerage system at Wyckoff Heights, L. I., N. Y.

Sewers are to be constructed in the Mount Pleasant district, at Providence, R. I. The estimated cost is $125,000.

Twelve to sixteen-inch pipe sewers have been recommended by the supervisors of San Francisco, Cal., to be constructed.

The council of Jamestown, N. Y., has contracted with O. N. Gardner, to make surveys and estimates for a sewer system.

Six thousand two hundred and eighty-three feet of brick and tile sewers will be constructed in various parts of Sheboygan, Wis.

The city of Huntington, Ind., proposes to spend $60,000 in converting a small creek which flows through the city into a sewer.

Olympia, Wash., has engaged an engineer to provide plans and superintend the construction of a sewer system for that place.

In addition to the usual appropriation of $25,000 for sewers at Brookline, Mass., the council has voted $16,500 for a sewer in Beacon street.

The National Construction Company has the sewer contract at Revere, Mass., and the work will be completed by Nov. 1, at a cost of $49,000.

Ed Cawley received the contract for furnishing 500,000 bricks for the building of the Moore street and Westford street sewers at Lowell, Mass.

The council of Lansing, Mich., has ordered the Michigan avenue sewer constructed from Grand River to Bingham street at a cost of about $2,400.

The contractor expects to have the sewers in district No. 2, Fostoria, O., completed by June 1. Work is progressing rapidly on same, and bids will be received about the 1st of June for the construction of district No. 1.

The new plans for placing the sewers in the middle of the streets through the business parts of Redland, Cal., have been accepted by the city trustees.

Bids are asked until May 26th for brick and pipe sewers at Battle Creek, Mich.; separate bids for brick, pipe and cement. W. W. Brigden, chief engineer.

Miller & McDougal submitted the lowest bid for about twenty miles of sewers at Hornellsville, N. Y., being over $53,000 lower than the highest bid received.

E. H. Bradbury received the contract for extending the Ohio avenue sewer about 1,000 feet to the river at Kansas City, Kan., in consideration of $15.40 per foot.

A resolution was passed by the board of aldermen authorizing a loan of $50,000 for ten years, to pay for the construction of sewers and drains at Lowell, Mass.

The contracts awarded for sewers on James, Arch and Wolcott streets and Batchley and Saltonstall avenues at New Haven, Conn., amounted to $16,819.90.

It is necessary to tunnel under the Old Colony Railroad tracks, at New Bedford, Mass., for the extension of the Sawyer street sewer. Work is being pushed rapidly.

A trunk line as a basis for a system of sewers has already been planned and surveyed at Oberlin, Ohio, and the work will be done in a systematic and permanent manner.

Eleven miles of sewers will be built at Aurora, Ill., this summer. The Rockford Construction Company was the lowest bidder on the work and was awarded the contract for $56,000.

Dr. J. H. Stallard, in a polyclinic lecture at San Francisco, advocated that small sewers are best and said that one 14 inches in diameter is capable of carrying away the house sewage of 50,000 people.

A new sewer will be built on Washington street from Noble to Rural streets, a distance of some two miles, at Indianapolis, Ind. It will be four feet in diameter, and conform to the system outlined by expert Hering.

Ransome, Cushing & Co. were awarded a $6,400 contract for building various branches of the outfall sewer at San Rafael, Cal. Francis, Smith & Co. were awarded the contract for furnishing the pipe at a bid of $4,828.

J. W. Farrell & Co. received the contract for sewerage and water piping of the stock yards at Salt Lake City, Utah. The sewer piping will extend 3,000 feet, and will be eight and twelve inches in diameter, laid in Utah cement.

Map and plans for a complete system of sewers for West Duluth, Minn., is being prepared by the village engineer. He expects to have all plans and specifications completed by July 1st, when work will be commenced on the sewers.

At Rochester, N. Y., Rauber & Vicinus were awarded a contract for sewers in section one at a bid of $113,361.75, and Chambers & Casey were awarded a contract for sewers in section two at a bid of $94,371.15 by the East Side Sewer Commission.

One hundred and fifty thousand dollars will be spent on new sewers this season at Pittsfield, Mass. A contract for eleven miles has been awarded to H. C. Eyre, of Chester, Pa., for $93,000. This contract is for the building of the west trunk sewer.

The construction of three sewers has been recommended at Spokane, Wash., by the board of public works: On Seventh avenue from Washington to Saxon streets; Washington from Sixth to Eighth avenues, and on Second avenue from Washington to Howard streets.

Two new sewerage systems are proposed for Albany, N. Y. One is for a high level intercepting sewer emptying into the river at the lower end of the city to cost $1,200,000, and the other is for a low level intercepting sewer along the river front, emptying at about the same place as the other, and to cost $500,000.

The city council of New Orleans has lately been wrestling with a proposition looking to the construction of a sewerage system in that city, and adopted an ordinance granting to a private corporation the exclusive privilege of putting in such works. When the ordinance went to Mayor Shakespeare he viewed it with distrust. He sent to Memphis for a sketch of the plan upon which the sewer system of that city was built and operated, and President W. L. Clapp sent him the desired information. Before this information reached New Orleans, however, it became necessary for Mayor Shakespeare to act on the ordinance one way or another, and he returned it to the council with his veto. The veto appears to have been applied "on suspicion," for the mayor alleged only general reasons for not approving the measure, saying that it had been put through hastily and without the proper consideration necessary for a matter of such great importance.

BRIDGES.

Franklin, Pa., will bridge the Allegheny river.

Waterford, Ont., will have a new bridge over the G. T. R. on Main street.

A $5,000 iron bridge will span Cedar river at Putnam street, at Williamstown, Mich.

A new bridge will be erected across Snohomish river at Everett, Wash., to cost $10,900.

The council of Fort Hope, Ont., has decided to erect a bridge over the harbor on Cage street.

Saginaw, Mich., will issue bonds for $200,000 to pay the expense of erecting two more bridges.

J. H. Colvin & H. D. Larimer are to build three bridges across the new ditches at Grantville, Kan.

A wrought-iron bridge will be constructed over the Buffalo river on Bailey avenue at Buffalo, N. Y.

A stone bridge is to be erected over the Farmer's Ditch, at the upper end of Pine street, at Boulder, Colo.

It is probable that six large steel bridges will be built across the Harlem river, New York, at a cost of $13,000,000.

Clinton, Iowa, will dedicate its high wagon bridge on the Fourth of July, as it is expected to be completed by that time.

It is announced that a highway bridge will probably be built over the Missouri river at St. Charles, Mo., at a cost of $250,000.

It is expected that the Monroe street bridge at Spokane, Wash., will be completed in the early part of June. The Edison Illuminating Company have offered to light the bridge with twelve arc lights free of charge.

Charles H. Young and E. B. Blaisdell were awarded a contract for a pile and timber bridge over Cape Neddick river at York Beach, Maine.

A new bridge will be built over Temescal creek at the end of Telegraph avenue at San Francisco, Cal. The bridge will be 100 feet wide by 125 feet long.

The city council of Cleveland, Ohio, has now under consideration a bill authorizing an appropriation of $50,000 for the reconstruction of the Swiss street bridge.

A bridge 150 feet long with a 20 foot roadway is to be built over Big Walnut creek, Truro Twp., Franklin county, Ohio, for which bids will be received until May 31st.

It has been decided by the board of trade of Winona, to formally open to traffic the high wagon bridge across the Mississippi at that place, with a big celebration on the Fourth of July.

An effort is being made at Marinetta, Wis., to construct a bridge across the Menominee river near Wallace, Mich. It is claimed that it would greatly benefit Wisconsin farmers in that vicinity.

The county commissioners of Belmont county, W. Va., will have five new highway bridges to build early this spring over McMahon's and Wheeling creeks. The cost of the five is estimated at $60,000.

Kettle river sandstone will be used in constructing the bridge across the St. Louis river at New Duluth. The pile work must be ready for the masonry by May 10, and the masonry must be finished by June 1.

A bill is to be introduced in the New York legislature to authorize the City of Rochester to issue bonds to provide for the construction of three bridges across the Genesee river at Court, Adams and Clarissa streets.

An election was held at Mt. Vernon, Wash., for the purpose of voting $12,000 in bonds to assist the county in putting a wagon bridge across the Skagit river at that place. It resulted in an unanimous vote in favor of the bonds.

A great steel bridge across the Columbia river at Vancouver, Wash., will be one of the most notable, as well as gigantic constructions of its kind. The pivotal pier will support a draw giving an opening of as much as 200 foot space on either side, for vessels to pass.

WATER-WORKS.

Hickman, Ky., is to have water-works.

Elgin is to have $100,000 more of new water-mains.

Stephenville, Tenn., will soon have a system of water-works.

Tama City, Ia., has let the contract for water-works at $11,078.50.

A system of water-works is to be built at West Liberty, Ia., to cost $45,000.

The contract has been let for water-works at Donaldsonville, La., for $9,917.

It is expected that Colfax, Wash., will have a water-works system completed by July 1.

A bill passed the house to allow Bryan, Ohio, to bond itself for $30,000 to build water-works.

Muskegon, Mich., is now supplied with pure lake water. The water-works have been completed.

A new system of water-works will be put in at Rockvale, Colo., by Geo. Shields, in consideration of $21,900.

The Chicopee Water Company, at Chicopee, Mass., will make $50,000 worth of improvements on its works.

A new water-works tower is being constructed at St. Joseph, Mich. It will be one of the highest in the state.

Water-works are to be built at Bastrop, Clifton, Elgin, Midlothian and Springtown, Tex.; Oxford, Ala., and Newport, Ky.

For the purpose of supplying West Berkley, Cal., with water, a new reservoir is being constructed which will cost $9,000.

A new pumping station is to be built at the water-works at Portsmouth, N. H. A. Brackett, of that place, received the contract.

Eaton, Ohio, has a $70,000 system of water-works which is highly satisfactory. The town has nine miles of piping and 72 fire hydrants.

The city water-works of Philadelphia, Pa., has a giant pump which weighs nearly 1,000,000 pounds and moves 20,000,000 gallons of water.

Atlanta, Ga., is now building a grand system of water-works, the supply for which will come from the rapidly flowing Chattahoochee river.

Geo. C. Morgan, of Chicago, was awarded the contract for constructing water works at Bedford, Ind. The capacity will be 300,000 gallons daily and cost $65,628.

An immense storage reservoir with a capacity of from 500 million to 800 million gallons of water is to be built by the water-works company at Sedalia, Mo., during the present year.

The water-works company at Sedalia, Mo., perfected arrangements for the construction of a reservoir of a capacity of over 500,000,000 gallons, and will cost upwards of $50,000.

The Boston water board has a scheme in contemplation for a greater water supply, which, if carried out, will mean the expenditure of $20,000,000. The plan is to get its supply 100 miles away.

Ninety thousand bricks and over twenty-four cords of stone were used in building the foundation to receive the enormous weight of the new pump at the water-works at Grand Rapids, Mich.

Without the apparent knowledge of its opponents, the bill authorizing Cincinnati to expend $6,000,000 for water-works and for the appointment of a commission to have charge of the same, became a law.

J. J. Moore & Co., of Hingham, Mass., received the contract to do the ditch digging and laying twelve miles of water pipe at Lancaster, N. H. The work is to be completed by August 1, for which $16,000 is to be paid.

Redwood Falls, Minn., will have a water-works system complete by July 1. The water is to be supplied from mineral springs, therefore will be very pure for domestic use. H. H. Harrison & Co., of St. Paul, are building same.

Jager & McMullen were awarded the contract for building water-works at Corpus Christi, Tex. The entire plant will cost $200,000 and water will be conveyed through 10-inch mains from the Nueces river, 15 miles west of the city.

Several thousand dollars worth of repairs will be put on the water-works at Wabash, Ind. The settling basin will be walled up and cemented, making an excellent reservoir and almost double the capacity of the one in use since the works were built, and various other improvements will be made.

Joseph Nalle purchased the franchise of the Austin Water and Light Company at Austin, Tex. The water and light service will be improved under the new management in which Mr. Huey, of Philadelphia, and Mr. Shaw, of Baltimore, are directors.

A gravity system of water-works is to be built at Ilion, N. Y. The plans and specifications were prepared by the Stanwix Engineering Company of Rome. The source of supply for the works is found in Hawks Creek, three miles from Ilion at an elevation of 500 feet above the city.

The water-works system at Peoria, Ill., comprises 97 miles of water-mains from four to thirty inches, 1,000 fire plugs, 960 circuit gates, three pumps with a capacity of $7,500,000 each in twenty-four hours, two stand-pipes which contain 1,000,000 and a reservoir holding 2,000,000 gallons.

There is a move on foot to establish a system of water-works at Westfield, Pa. A water company has been formed and a charter granted. It is altogether probable that some definite arrangements will be made for putting in a system the coming season, either by home or outside capital.

STREET LIGHTING.

LaGrange, Ga., has voted to issue bonds for electric lights.

Seattle, Wash., is investigating the subject of electric lighting.

The streets of Big Rapids, Mich., are to be illuminated by electricity.

Hickman, Ky., is to have electric lights in connection with water-works.

Bonds for $25,000 will be issued to establish an electric light plant at Etna, Pa.

An electric light plant to cost $20,000 will be erected by the city of Wapakoneta, Ohio.

J. N. Graves has a contract with the city of Henrietta, Tex., to light the town for five years.

The council has voted to issue bonds for a $20,000 electric light plant for Martin's Ferry, Ohio.

The electric light company at Alexandria Bay, Ont., contemplates putting in a large dynamo.

A municipal electric light plant will be built at Tacoma, Wash., for which bonds will be issued.

It is reported that the Malden (Mass.) Electrical Company is about to duplicate its lighting plant at a cost of $50,000.

An incandescent lighting plant will be put in at Columbus, Ind. Local merchants have organized a company with a capital of $20,000,

It has been recommended by the Committee on Water and Lights at McKeesport, Pa., that the city build a new plant to cost $55,000.

The Thompson-Houston system will be used by the Rockville Electric Light and Power Company for lighting the streets of Rockville, Ind., at a cost of $70 per year per light.

The Louisiana Electric Light Company was awarded the contract for lighting the City of New Orleans, La., with electricity for a period of ten years at $127 per light per year.

Lansing, Mich., is now paying $95 per light per year and the city is considering the feasibility of establishing a municipal plant with a capacity of 100 lights which can be run at an expense of $75 per light per year.

SEALED PROPOSALS.

Notice to Brick Paving Contractors:

The city council of Oskaloosa, Iowa, will receive sealed bids up to 7:30 p. m., June 1st, for brick paving. Certified check for 10 per cent. of whole cost, as evidence of good faith, must accompany bid.

Approximate estimate:

Sq. yds. brick paving	9210
Lineal ft. cement curbing	2880
Lineal ft. brick curbing	1000
Excess grading (cu. yds.)	2000

Write for specifications.

By order of City Council.

F. M. SHANGLE, City Clerk.

DITCH SALE

Chas. E. Perkins, Civil Engineer, will offer for sale at the court-house at Akron, Summit County, Ohio, The Tuscarawas River Ditch Improvement, on Tuesday, May 24th, 1892. Estimated cost of ditch construction, about $30,000.00.

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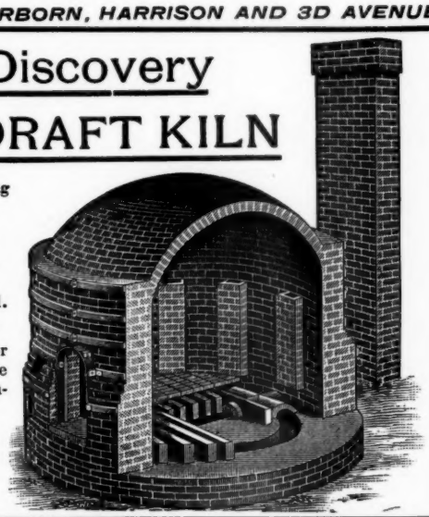

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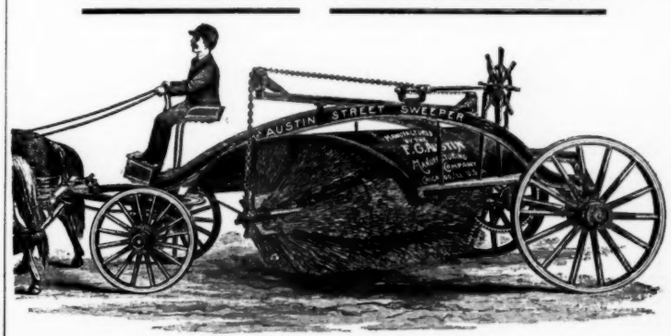

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PATENTEE.

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IRON BOUND AND NON-BREAKABLE.

PATENTED MAY 20, 1890.

ESPECIALLY ADAPTED FOR STREETS, WHARVES, RAILROAD DEPOTS, PIERS, ROADWAYS OF BRIDGES, MARKET HOUSES, BREWERIES, WAREHOUSES, ETC., ETC.

THE INVENTOR of the Anchor Iron Bound Curb has been for several years engaged in the business of laying Artificial Stone Pavements, and has put down large quantities of Cement Curbing, as at present used. THIS HAS ONE SERIOUS DEFECT, viz.: The liability to break or chip off at the outside edge or corner, from the impact of wheels of vehicles of all kinds trucks, coal carts, milk or express wagons; even wheelbarrows or bakers' carts will chip off pieces when rudely pushed against this edge, and destroy its symmetry.

The effort to overcome this objection has resulted in the present patented improvement, which is designated

THE ANCHOR ARTIFICIAL CURB.

ITS ADVANTAGES ARE

Greatly reduced cost as compared with Granite Curbing, which it will, in time, entirely supplant, as it is superior in appearance and finish.

It is provided on the outside edge with an iron plate, which strengthens as well as protects it from wear, and breaking from contact with cart or wagon wheels, or other causes of injury. This plate, being galvanized, does not discolor the face of the curb.

In addition to this, two bars of angle iron form the front and back of the bottom of the curb, making it **Iron Bound** on THREE corners, and tie rods are imbedded in the concrete for its entire length, giving it strength equal to granite, and making it absolutely **non-breakable.**

This curb is continuous throughout its entire length, and has no joints to separate and get out of position, as the short lengths now used of the ordinary stone invariably do, after a few years of use.

Although lighter, and containing less material than the heavy stones now used, it has a strong iron frame, resting on foundation pieces, which are buried deeper than the curbstones now in use, and provided with **Anchor Plates,** which make it immovable under any circumstances.

While it is an ornamental improvement to private dwellings, it is of great value in such places as the yards of breweries, and the vicinity of market-houses, warehouses, etc., where heavy wagons are continually backing up to receive or discharge their loads.

For railroad depots, wharves, piers and shipping docks, also driveways for bridges, it will prove of great benefit, and will outlast any other kind of Curbing that could be used.

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It is superior in finish and appearance to Granite or Blue-stone, and fully its equal in strength. It has been laid for some months in Washington, and subjected almost daily to severe tests, and fully justifies all representations made regarding it.

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PROFESSIONAL CARDS.

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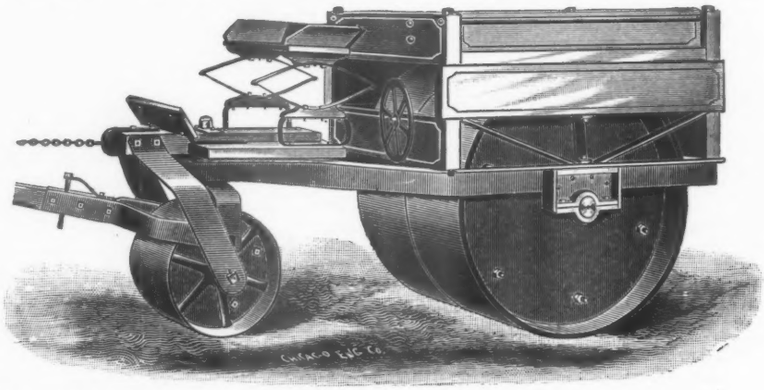

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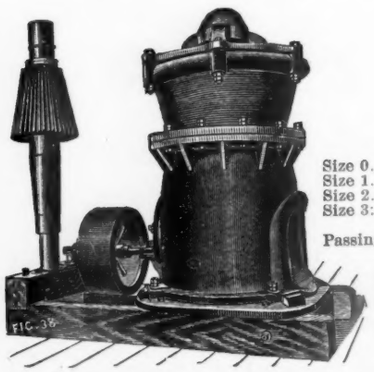

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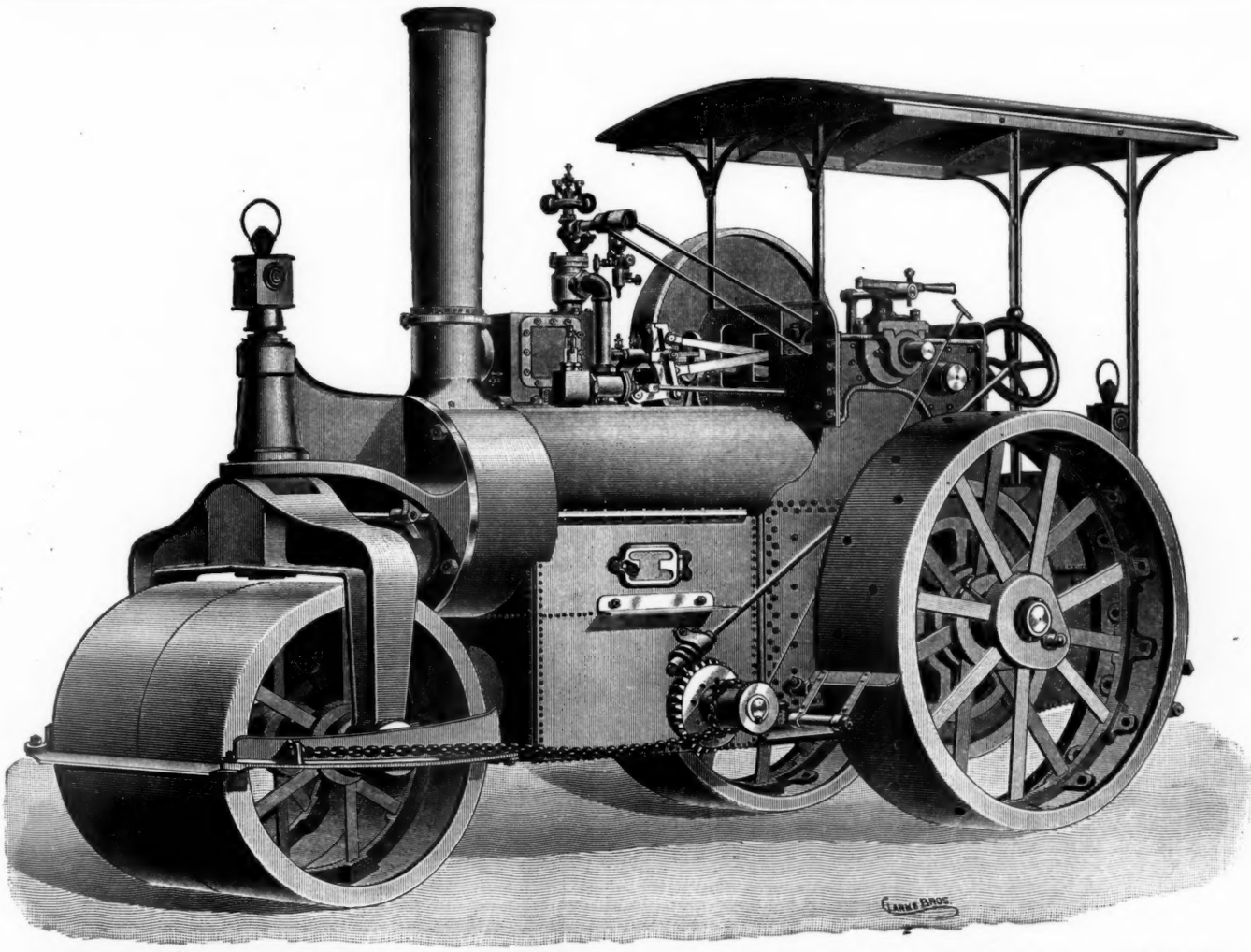

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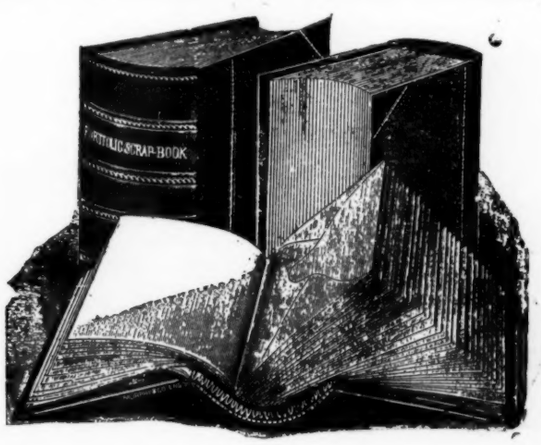

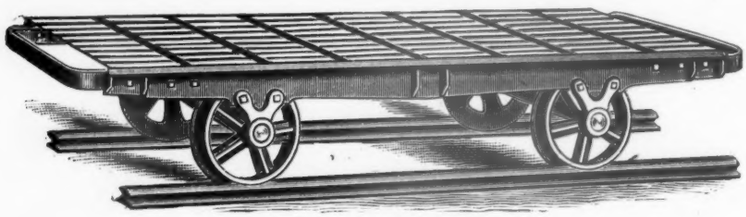

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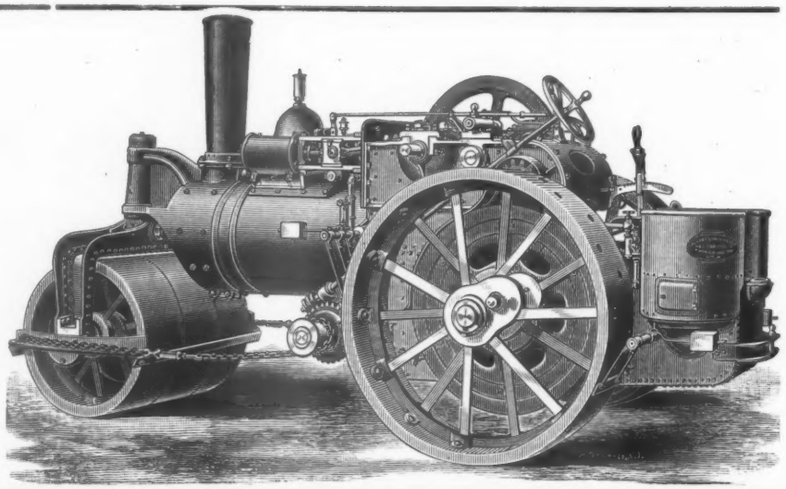

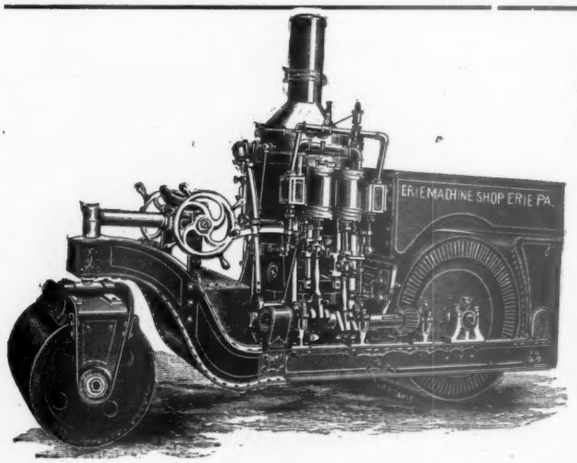

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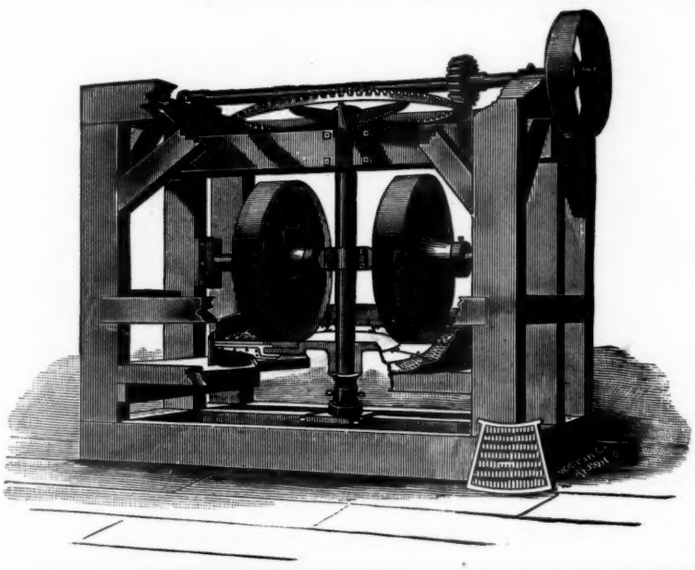

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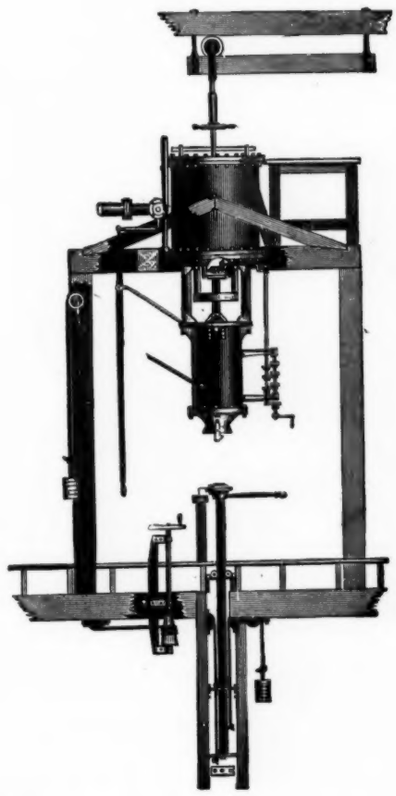

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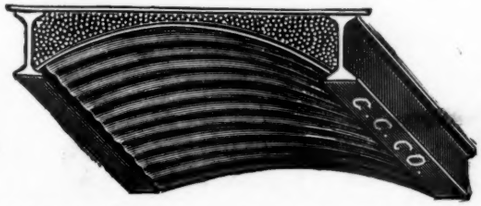

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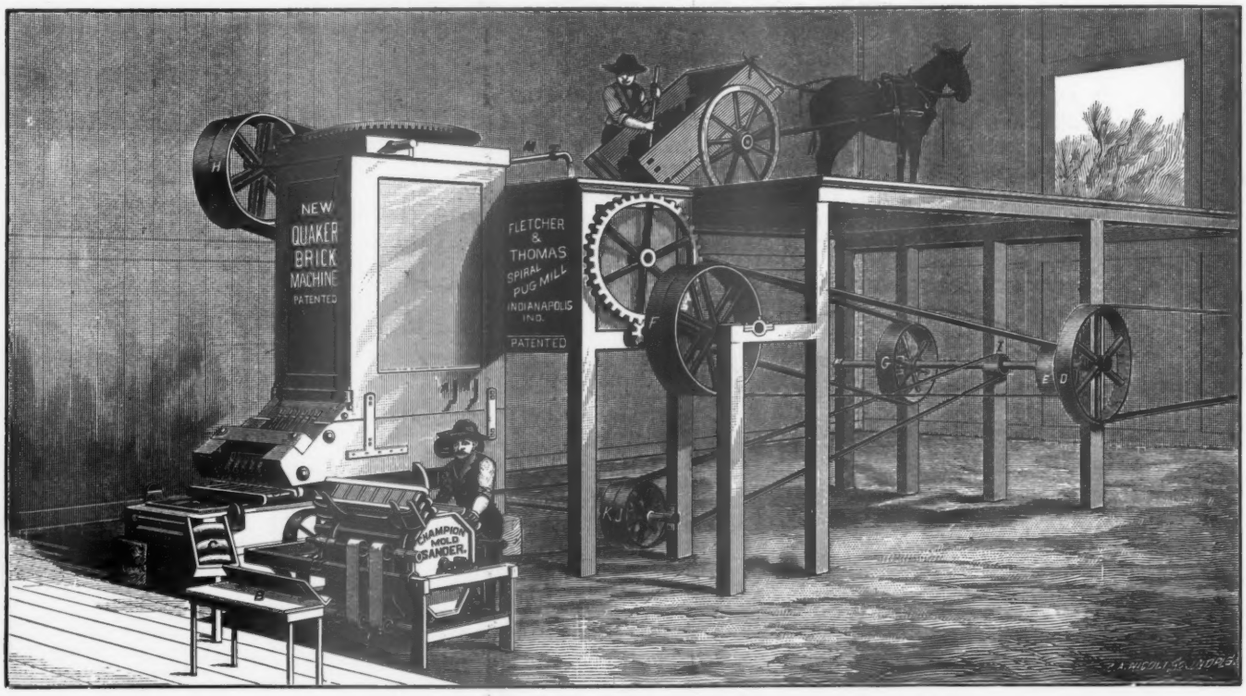

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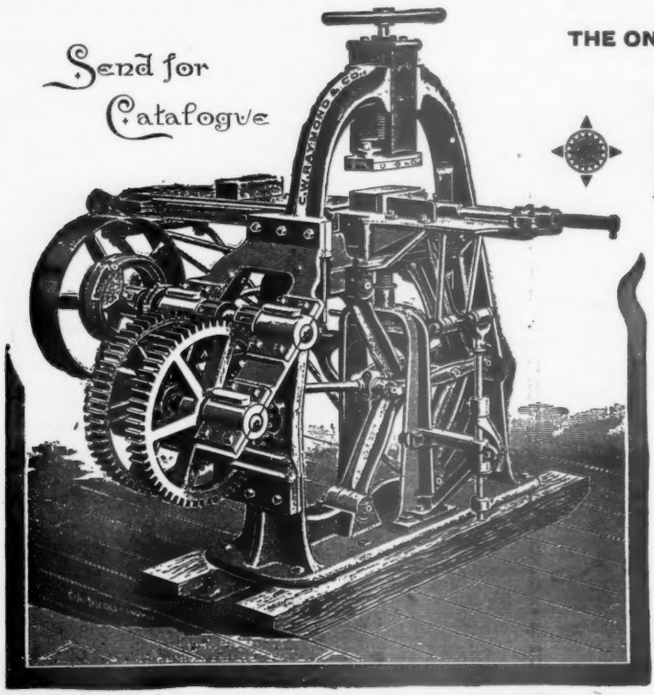

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